

COMPOSITE LAMINATE AND METHOD FOR MAKING THE SAME
BACKGROUND OF THE INVENTION

1. Field of the invention.

This invention relates to a composite laminate,
5 more particularly to a composite laminate having a
fabric sheet bonded to a thermoplastic sheet through
a polyurethane elastomer film and to a method for
making the same.

2. Description of the related art

10 Articles, such as the housing of a computer or
a cellular phone, the upper of a shoe, and a golf bag,
are normally made from a composite laminate that
includes a carbon fiber-made fabric laminate
consisting of a plurality of fabric sheets, each of
15 which is impregnated with epoxy resin. The fabric
laminate is subsequently coated with a polyurethane
layer thereon by spraying repeatedly polyurethane
thereto so as to obtain a smooth surface on the fabric
sheet. The fabric laminate is dried after each
20 spraying operation, which results in a relatively
long time to prepare the fabric laminate for the next
spraying operation. Moreover, hand stitching is
difficult for the composite laminate due to the
presence of epoxy resin in the composite laminate.

25 Another conventional composite laminate
includes a fabric sheet, a thermoplastic sheet
adhesively bonded to one side of the fabric sheet

through an adhesive, and a polyurethane film coated on an opposite side of the fabric sheet to obtain a smooth surface on the opposite side of the fabric sheet. The conventional composite laminate is disadvantageous in that the aforesaid adhesive takes a relatively long time to harden, that the fabric sheet tends to peel off from the thermoplastic sheet, and that bubbles are formed in the adhesive due to the presence of solvent in the adhesive, which has an adverse effect on the appearance of the article to be made from the composite laminate.

SUMMARY OF THE INVENTION

Therefore, the object of the present invention is to provide a composite laminate that is capable of overcoming the aforesaid drawbacks of the prior art.

According to one aspect of the present invention, there is provided a composite laminate that includes: a fabric sheet which is surface-treated with a amine-containing surface agent; a thermoplastic sheet; and a polyurethane elastomer film interposed between the fabric sheet and the thermoplastic sheet. The fabric sheet, the thermoplastic sheet and the polyurethane are thermally pressed to form a stack in such a manner that the polyurethane elastomer film penetrates into the fabric sheet, reacts with the surface agent to form a -CONH bonding therebetween,

and is bonded to the thermoplastic sheet.

According to another aspect of the present invention, there is provided a method for making a composite laminate. The method includes the steps of:

5 stacking a fabric sheet, a polyurethane elastomer film and a thermoplastic sheet together to form a stack, the polyurethane elastomer film being disposed between the fabric sheet and the thermoplastic sheet; and hot pressing the stack in such a manner so as to

10 permit penetration of the polyurethane elastomer film into the fabric sheet and adhesive bonding of the polyurethane elastomer film to the thermoplastic sheet.

BRIEF DESCRIPTION OF THE DRAWINGS

15 In drawings which illustrate an embodiment of the invention,

Fig. 1 is a block diagram illustrating consecutive steps of the preferred embodiment of a method for making a composite laminate according to

20 the present invention;

Fig. 2 is a fragmentary sectional view of the composite laminate formed according to the embodiment of the method of this invention; and

Fig. 3 is a perspective view of an article made

25 from the composite laminate of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figs. 1 and 2 illustrate the preferred

embodiment of a method for making a composite laminate 2 according to the present invention.

The method of this invention includes the steps of: surface-treating a fabric sheet 21 with an amine-containing surface agent by impregnating the fabric sheet 21 in a solution containing the amine-containing surface agent; stacking the surface-treated fabric sheet 21 with two polyurethane elastomer (TPU) films 22 and two thermoplastic sheets 23 to form a stack (see Fig. 2), each polyurethane elastomer film 22 being disposed between the fabric sheet 21 and a respective one of the thermoplastic sheets 23 (note that when only one thermoplastic sheet 23 is used, one of the polyurethane films 22 will be exposed to the atmosphere and forms a smooth surface on the fabric sheet 21); and hot pressing the stack in such a manner so as to permit penetration of each polyurethane elastomer film 22 into the fabric sheet 21, reaction of each polyurethane elastomer film 22 with the surface agent to form a -CONH bonding therebetween, and adhesive bonding of each polyurethane elastomer film 22 to the respective thermoplastic sheet 23. In this embodiment, the hot pressing is conducted at a temperature ranging from 120-180°C, a pressing pressure ranging from 2-10 Kg/cm², and a pressing time ranging from 60-250 seconds.

Preferably, each thermoplastic sheet 23 is made

from a material selected from the group consisting of polyvinyl chloride, acrylonitrile-butadiene-styrene copolymer, polystyrene, polycarbonate, and polyester.

5 The fabric sheet 21 is preferably made from synthetic fibers, carbon fiber, and glass fiber, and is more preferably made from carbon fiber.

 The amine-containing surface agent can contain monoamines, diamines, or triamines. Preferably, the
10 amine-containing surface agent contains a diamine compound.

 Fig. 3 illustrates an article 10 made from the composite laminate 2 of this invention. The composite laminate 2 is cut into a predetermined size, and is
15 subsequently subjected to compression molding in a mold (not shown) under a molding temperature ranging from 100-130 °C, a molding pressure ranging from 2-10 Kg/cm², and a molding time ranging from 60-180 seconds.

 Since each polyurethane elastomer film 22
20 penetrates into the fabric sheet 21 and reacts with the surface agent to form a -CONH bonding therebetween, each thermoplastic sheet 23 can be firmly bonded to the fabric sheet 21. In addition, by hot pressing the stack according to the method of this invention, the
25 long waiting time for drying the adhesive as required in making the conventional composite laminate and the presence of the bubbles are eliminated.

With the invention thus explained, it is apparent that various modifications and variations can be made without departing from the spirit of the present invention.